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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/812,403 | 03/20/2001 | James Stewart Rankin II | 200-1202 | 3386 |

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KEVIN G. MIERZWA
ARTZ & ARTZ, P.C.
28333 TELEGRAPH ROAD, SUITE 250
SOUTHFIELD, MI 48034

| EXAMINER | |
|---|---|
| THANGAVELU, KANDASAMY | |
| **ART UNIT** | **PAPER NUMBER** |
| 2123 | |

DATE MAILED: 02/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/812,403 | RANKIN ET AL. | |
| | Examiner | Art Unit | |
| | Kandasamy Thangavelu | 2123 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *24 November 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *20 March 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8/13/2001 and 8/25*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

1. This communication is in response to the Applicants' amendment dated on November 24, 2004. Claims 7, 9 and 10 were amended. Claims 1-10 of the application are pending. This office action is made non-final.

### *Information Disclosure Statement*

2. Acknowledgment is made of the receipt of the copies of the papers listed in the information disclosure statements filed on August 13, 2001 and August 16, 2002. The papers have been considered.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

4. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 1-14 and 16-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Xi et al.** (U.S. Patent 6,597,967) in view of **Sheng et al.** ("CAD-Guided robot motion control for sensor planning", Presented at WACONG, 2000 and submitted by the applicants as part of the IDS).

5.1 **Xi et al.** teaches System and method for planning a tool path along a contoured surface. Specifically, as per claim 1, **Xi et al.** teaches a method automatically determining one or more sensor locations for sensing a surface of a physical part (CL1, L8-10; CL2, L23-27; CL2, L41-44; CL4, L37-41); comprising:

inputting a CAD model, which is representative of the surface of the physical part, into a sensor planner (CL1, L24-29; CL2, L60-64);

subdividing the CAD model of the surface of the physical part into a plurality of discrete partitions (CL3, L35-38); and

grouping the plurality of discrete partitions into one or more subgroups based on visibility criterion (CL3, L52-59; CL4, L26-29).

**Xi et al.** teaches inputting a sensor model, which is representative of a 3D image capturing sensor, into the sensor planner (CL3, L1-7; Cl2, L44-45). **Xi et al.** does not expressly

teach inputting a sensor model, which is representative of a 3D digital_image capturing sensor, into the sensor planner. **Sheng et al.** teaches inputting a sensor model, which is representative of a 3D digital image capturing sensor, into the sensor planner (Page 5, Para 4 and 5; The Hitachi KP-D50 camera used by **Sheng et al.** is a digital camera), as that provides the camera parameters such as focus and resolution required for surface inspection (Page 2, Para 6). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Xi et al.** with the method of **Sheng et al.** that included inputting a sensor model, which is representative of a 3D digital image capturing sensor, into the sensor planner. The artisan would have been motivated because that would provide the camera parameters such as focus and resolution required for surface inspection.

**Xi et al.** teaches outputting automatically a set of viewing positions and orientations for the sensor (CL3, L6-8; CL3, L59-67; CL4, L22-28). **Xi et al.** does not expressly teach outputting automatically a set of viewing positions and orientations for the digital sensor. **Sheng et al.** teaches outputting automatically a set of viewing positions and orientations for the digital sensor (Page 5, Para 4 and 5; The Hitachi KP-D50 camera used by **Sheng et al.** is a digital camera), as that provides the camera parameters such as focus and resolution required for surface inspection (Page 2, Para 6). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Xi et al.** with the method of **Sheng et al.** that included outputting automatically a set of viewing positions and orientations for the digital sensor. The artisan would have been motivated because that would provide the camera parameters such as focus and resolution required for surface inspection.

Per claim 2: **Xi et al.** teaches that the plurality of discrete partitions are formed in the shape of triangles (CL3, L33-38).

Per claim 3: **Xi et al.** teaches that the grouping further comprises selecting a seed partition from the plurality of partitions (CL3, L53-64).

Per claim 4: **Xi et al.** teaches that the grouping further comprises forming at least one flat patch, which includes all partitions adjacent the seed partition having a normal vector that forms an angle with an average normal of the grouping that is less than a predetermined value (CL3, L53-59; CL3, L65 to CL4, L14).

Per Claim 5: **Xi et al.** teaches forming a plurality of flat patches that together capture the entire surface of the physical part (CL3, L51-59; CL4, L26-29).

Per claim 6: **Xi et al.** teaches constructing a bounding box around the at least one flat patch, the bounding box having a front face representing a direction where the projected area of the at least one flat patch onto the front face is maximized (CL4, L47-54).

Per claim 7: **Xi et al.** teaches determining the sensor position closest to the surface that encompasses all of the at least one flat patch (CL4, L54-59; CL5, L2-4).

Per claim 8: **Xi et al.** teaches determining the sensor position farthest from the surface of the part that meets predetermined resolution requirements (CL5, L4-7).

Per claim 9: **Xi et al.** teaches locating a sensor position that meets the predetermined resolution requirements (CL5, L8-21).

Per claim 10: **Xi et al.** teaches outputting the located sensor position to a controller in order to automatically position the sensor (CL2, L33-34; CL2, L41-44; CL3, L25-28; CL4, L37-41).

Per claim 11: **Xi et al.** teaches splitting the at least one flat patch if the front face is too large for the sensor to capture the at least one flat patch and satisfy the predetermined resolution requirements (CL5, L22-27).

5.2 As per claim 12, **Xi et al.** teaches an automated CAD-guided sensor planning system (CL1, L8-10; CL2, L23-27; CL2, L41-44; CL4, L37-41; Fig. 2; CL1, L24-29; CL2, L60-64); comprising:

a CAD model, which is a computer representation of one or more surfaces of a physical object that are to be measured (CL1, L24-29; CL2, L60-64).

**Xi et al.** teaches a sensor model, which is a mathematical representation of a 3-D image capturing sensor (CL3, L1-7; Cl2, L44-45). **Xi et al.** does not expressly teach a sensor model, which is a mathematical representation of a 3-D digital image capturing sensor. **Sheng et al.** teaches a sensor model, which is a mathematical representation of a 3-D digital image capturing sensor (Page 5, Para 4 and 5; The Hitachi KP-D50 camera used by **Sheng et al.** is a digital camera), as that provides the camera parameters such as focus and resolution required for surface

inspection (Page 2, Para 6). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the system of **Xi et al.** with the system of **Sheng et al.** that included a sensor model, which was a mathematical representation of a 3-D digital image capturing sensor. The artisan would have been motivated because that would provide the camera parameters such as focus and resolution required for surface inspection.

**Xi et al.** teaches a sensor planner that receives the CAD model and the sensor model and utilizes them to automatically determine a set of sensor viewing positions and orientations. (CL3, L6-8; CL3, L59-67; CL4, L22-28). **Xi et al.** does not expressly teach a sensor planner that receives the CAD model and the sensor model and utilizes them to automatically determine a set of sensor viewing positions and orientations for the digital image capturing sensor. **Sheng et al.** teaches a sensor planner that receives the CAD model and the sensor model and utilizes them to automatically determine a set of sensor viewing positions and orientations for the digital image capturing sensor (Page 5, Para 4 and 5; The Hitachi KP-D50 camera used by **Sheng et al.** is a digital camera), as that provides the camera parameters such as focus and resolution required for surface inspection (Page 2, Para 6). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Xi et al.** with the method of **Sheng et al.** that included a sensor planner that receives the CAD model and the sensor model and utilizes them to automatically determine a set of sensor viewing positions and orientations for the digital image capturing sensor. The artisan would have been motivated because that would provide the camera parameters such as focus and resolution required for surface inspection s.

Per claim 13: **Xi et al.** teaches that the sensor model includes descriptions of one or more variables about the sensor: visibility, resolution, field of view, focal length and depth of field (CL5, L41-44).

Per Claim 14: **Xi et al.** teaches a controller for receiving the set of sensor viewing positions and orientations and using them to control a physical device to locate the sensor accordingly (CL2, L33-34; CL2, L41-44; CL3, L25-28; CL4, L37-41).

Per Claim 16: **Xi et al.** teaches the physical device is a robot (CL1, L15-23; CL2, L33-34).

5.3 As per claim 17, **Xi et al.** teaches an automated CAD-guided sensor planning method (CL1, L8-10; CL2, L23-27; CL2, L41-44; CL4, L37-41; CL1, L24-29; CL2, L60-64); comprising:

providing a CAD model of a physical part to be examined (CL1, L24-29; CL2, L60-64);

tessellating at least one surface of the CAD model of the physical part by subdividing it into a plurality of partitions (CL3, L35-38);

determining at least one flat patch on the at least one surface, the flat patch being comprised of one or more of the plurality of partitions (CL3, L53-59; CL3, L65 to CL4, L14);

determining a closest position for the sensor to the at least one surface that encompasses all of the at least one flat patch (CL4, L54-59; CL5, L2-4);

determine a furthest position of the sensor to the at least one surface having sufficient resolution (CL5, L4-7).

**Xi et al.** teaches providing a sensor model representative of a 3-D image capturing device (CL3, L1-7; Cl2, L44-45). **Xi et al.** does not expressly teach providing a sensor model representative of a 3-D digital image capturing device. **Sheng et al.** teaches providing a sensor model representative of a 3-D digital image capturing device (Page 5, Para 4 and 5; The Hitachi KP-D50 camera used by **Sheng et al.** is a digital camera), as that provides the camera parameters such as focus and resolution required for surface inspection (Page 2, Para 6). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Xi et al.** with the method of **Sheng et al.** that included providing a sensor model representative of a 3-D digital image capturing device. The artisan would have been motivated because that would provide the camera parameters such as focus and resolution required for surface inspection.

**Xi et al.** teaches outputting a sensor location based on the closest position that encompasses the entire flat patch and the farthest position with sufficient resolution (CL5, L8-21). **Xi et al.** does not expressly teach outputting a digital sensor location based on the closest position that encompasses the entire flat patch and the farthest position with sufficient resolution. **Sheng et al.** teaches outputting a digital sensor location based on the closest position that encompasses the entire flat patch and the farthest position with sufficient resolution (Page 5, Para 4 and 5; The Hitachi KP-D50 camera used by **Sheng et al.** is a digital camera), as that provides the camera parameters such as focus and resolution required for surface inspection (Page 2, Para

6). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the method of **Xi et al.** with the method of **Sheng et al.** that included outputting a digital sensor location based on the closest position that encompasses the entire flat patch and the farthest position with sufficient resolution. The artisan would have been motivated because that would provide the camera parameters such as focus and resolution required for surface inspection.

Per claim 18: **Xi et al.** teaches that the at least one surface is subdivided into a plurality of triangles (CL3, L33-38).

Per claim 19: **Xi et al.** teaches determining a closest position for the sensor to the at least one surface that encompasses all of the at least one flat patch (CL4, L54-59; CL5, L2-4).

Per claim 20: **Xi et al.** teaches determining a furthest position of the sensor to the at least one surface having sufficient resolution (CL5, L4-7).

Per claim 21: **Xi et al.** teaches constructing a bounding box around the at least one flat patch, the bounding box having a front face representing a direction where the projected area of the at least one flat patch onto the front face is maximized (CL4, L47-54).

Per claim 22: **Xi et al.** teaches splitting the at least one flat patch if the front face is too large for the sensor to capture the at least one flat patch and satisfy the predetermined resolution requirements (CL5, L22-27).

6. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Xi et al.** (U.S. Patent 6,023,680) in view of **Merat et al.** (U.S. Patent 5,465,221).

6.1 As per claim 15, **Xi et al.** and **Sheng et al.** teach the system of claim 14. **Xi et al.** does not expressly teach that the physical device is a coordinate measurement machine. **Merat et al.** teaches that the physical device is a coordinate measurement machine (Abstract, L1-2; CL1, L24-29), as coordinate measurement machines are used extensively in industry for automated industrial inspection of machine parts (CL1, L27-29). It would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to modify the system of **Xi et al.** with the system of **Merat et al.** that included the physical device being a coordinate measurement machine. The artisan would have been motivated as coordinate measurement machines were used extensively in industry for automated industrial inspection of machine parts.

## ***Response to Arguments***

7.1 As per the applicants' argument that "the Wooster et al. reference does not teach or suggest the step of inputting or providing a CAD model of the surface to be measured. In fact, Wooster et al. teaches a system for measuring a physical shape or part with no matching digital CAD model information available", the examiner has used the **Xi et al.** reference.

**Xi et al.** teaches inputting a CAD model, which is representative of the surface of the physical part, into a sensor planner (CL1, L24-29; CL2, L60-64); and

subdividing the CAD model of the surface of the physical part into a plurality of discrete partitions (CL3, L35-38).

14.2 As per the applicants' argument that "Wooster et al. is only suited for an analog system – not a digital system; applicants' digital device addresses issues such as resolution constraint, which is key for a digital device to achieve the required precision; this accuracy is not considered by and not taught or suggested by Wooster et al.", the examiner has used a new reference, **Sheng et al.** in this Office action .

**Sheng et al.** teaches inputting a sensor model, which is representative of a 3D digital image capturing sensor, into the sensor planner (Page 5, Para 4 and 5; The Hitachi KP-D50 camera used by **Sheng et al.** is a digital camera), as that provides the camera parameters such as focus and resolution required for surface inspection (Page 2, Para 6).

## *Conclusion*

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Kandasamy Thangavelu whose telephone number is 571-272-3717. The examiner can normally be reached on Monday through Friday from 8:00 AM to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kevin Teska, can be reached on 571-272-3716. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-9600.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

K. Thangavelu
Art Unit 2123
January 27, 2005

KEVIN J. TESKA
SUPERVISORY
PATENT EXAMINER